through the transition again followed the lower branch of the hysteresis loop during both cooling operations. This is significant because the first cooling through the transition presumably involved the transition from face-centered-cubic to monoclinic crystal structure, whereas the second cooling involved the transition from rhombohedral monoclinic form (*2*) (Fig. 1). Hence, the existence of the hysteresis loop is not associated with the dual nature of the structure of the high-temperature form.

The actual causes of the hysteresis are difficult to determine. The temperature of the steel sample holder was normally held constant (within 0.1°K during a given measurement) as determined by thermocouples attached to its outer surface. I made a separate test in which the temperature of the die was compared with that of the exterior of the sample holder. Under static conditions the temperature difference was $\lesssim$ 0.1°K. However, during extrusion, the die temperature increased by ~1°K, the rise becoming greater as the extrusion rate was increased. The thermal energy released was quickly dissipated when the extrusion was stopped; the effect on the temperature of the outside of the sample holder was negligible. The extent to which the temperature of the sample was affected is difficult to estimate. The extrapolation to zero rate of piston advance used to determine the extrusion pressure should have minimized the effect. The observed width of the hysteresis loop, ~3°K, can probably not be attributed to systematic errors in the measurement of the sample temperature.

The effect of any rise in temperature caused by the extrusion is a lowering of the apparent transition temperature. This is countered by the effect of extrusion pressure on the phase transition. The applied pressure of ~100 bars should raise the apparent transition temperature about 2°K (*3*) if it is assumed that the phase boundaries of monoclinic face-centered-cubic and monoclinic rhombohedral forms are nearly coincident. Thermal measurements by several investigators indicate that this assumption is valid within ~0.3°K (*9*). There is also a possibility that the crystallographic transformations are displaced by the shear stresses experienced by the sample. The observed hysteresis is thus the result of several competing effects, their magnitudes being difficult to estimate.

In the measurements made in the temperature range above the transition temperature, the shaded (warming) points presumably indicate the shear strength of the rhombohedral form while the open (cooling) circles represent the face-centered-cubic phase. No difference in shear strength was observed within the experimental uncertainty ~5 percent). This result has two possible interpretations: (i) the shear strength of the rhombohedral and face-centered-cubic phases are not readily distinguishable on this basis, or (ii) observations were not made on both phases.

The plastic properties of the two high-temperature forms are expected to be similar because of their similar symmetries. Symmetry considerations also suggest that the strength of both of these structures should be markedly different from that of the monoclinic form. Because this difference was found to be only 25 percent, is is quite possible that between the rhombohedral and face-centered-cubic forms of carbon tetrachloride there is a difference which is below the sensitivity of this extrusion technique. It is also conceivable that the stress and strain associated with the extrusion process alters the relative stability of the two forms so that measurements were not actually made on both forms. Although the latter possibility seems unlikely, it cannot be ruled out on the basis of these measurements. However, neither the measurements in the high-temperature range nor the hysteresis effect provides evidence confirming the dual structure of carbon tetrachloride at high temperatures.

The temperature dependence of the shear strength of both the high- and low-temperature forms of carbon tetrachloride exhibits a gradual curvature rather than the linear dependence reported by Michils for several organic solids. If the data are approximated by a linear function on either side of the transition, a discontinuity in slope is observed at the transition temperature as expected from Michils' measurements. However, my data can also be approximated by a smooth curve with little or no discontinuity in slope, provided that the hysteresis loop is ignored. This suggests that the mechanical properties of the high-temperature plastic phase or phases are not qualitatively different from those of the low-temperature phase and that the discontinuity in slope reported by Michils may have been an artifact of his experimental procedure which involved only a few measurements made at relatively large temperature increments.

The mechanical properties of carbon tetrachloride can best be compared with those of other soft solids by our considering each material at equivalent values of reduced temperature, that is, T/T_m where T_m is the melting point of the material. When this is done, it is found that the shear strength of carbon tetrachloride near $T/T_m = 1$ is comparable to that of argon and krypton (*6*), but an order of magnitude smaller than that of silver chloride (*7*). However, the shear strength of carbon tetrachloride increases much more rapidly as the temperature is lowered than that of these other materials. This is apparently a reflection of the greater molecular complexity of carbon tetrachloride and its lower molecular symmetry.

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6-Methylpurine-H^3: Intracellular Localization in Pea Root Tip Cells

Abstract. *6-Methylpurine-H^3, a potent inhibitor, was detected by autoradiography in the nucleoli of pea root tip cells. Most of the radioactivity was in the nucleoli of growing cells in the meristematic region. Treatment of the labeled cells with ribonuclease indicates that 6-methylpurine-H^3 is incorporated into nucleolar RNA which then moves from the nucleolus to the cytoplasm.*

Several reports show that 6-methylpurine is a potent inhibitor of cell growth (*1*) and possibly of viral multiplication (*2*). In *Pelargonium* pith-cell cultures (*1*) and in pea roots (*3*), growth

was completely inhibited by this compound at $10^{-6}M$. The methyl group at the 6-position of the purine ring specifically inhibits cell growth.

The mode of action of 6-methylpurine is not well understood; it induced diffusion of phosphohexose isomerase and lactic dehydrogenase from rat-liver cells into blood (*4*) and it may act as a specific analogue of adenine in the synthesis of adenosine triphosphate and nucleic acid (*5*).

Alaska pea seeds were soaked in water overnight and placed on moist filter paper for 3 days (Fig. 1A). Seedlings were transferred to petri dishes containing Knop's solution and 6-methylpurine-H^3 (5 μc/ml) (*6*) before incubation at room temperature for 30 minutes or longer. The root tips were excised, fixed in a mixture of ethanol and acetate, and sectioned by standard procedures. Sections were attached to microscope slides with gelatin (50 mg in 25 ml of hot water), deparaffinized with xylene, rinsed in absolute ethanol, and covered with Kodak NTB_3 emulsion. The slides were stained with gallocyanin and chromalum (*7*) and mounted.

When pea seedlings were incubated with 6-methylpurine-H^3 for 1 hour, the nucleoli in the root-tip cells contained much labeled material (Fig. 1B). Approximately 48 percent of the nucleoli in the meristematic region of the root tip were heavily labeled, but those near the base of the root were not labeled. When the pea seedlings were treated with 6-methylpurine-H^3 for 1 hour, washed, transferred to the medium containing nonradioactive 6-methylpurine ($10^{-5}M$), and incubated at room temperature for 23 hours, although the cytoplasm contained much labeled material (Fig. 1C), the nucleoli contained less, the indication being that 6-methylpurine may stay in the nucleoli briefly before moving out into the cytoplasm.

In order to determine whether 6-methylpurine-H^3 is incorporated into nucleic acid in the nucleoli, the sections of pea root tip were treated with ribonuclease or deoxyribonuclease, or both, and incubated at room temperature for 1 hour. Autoradiography showed no change in the amount of labeled material in nucleoli and cytoplasm after treatment with deoxyribonuclease. However, almost all the labeled material was absent from the nucleolus and cytoplasm after treatment with ribonuclease (Fig. 1D), the indication being that the activity was present in RNA.

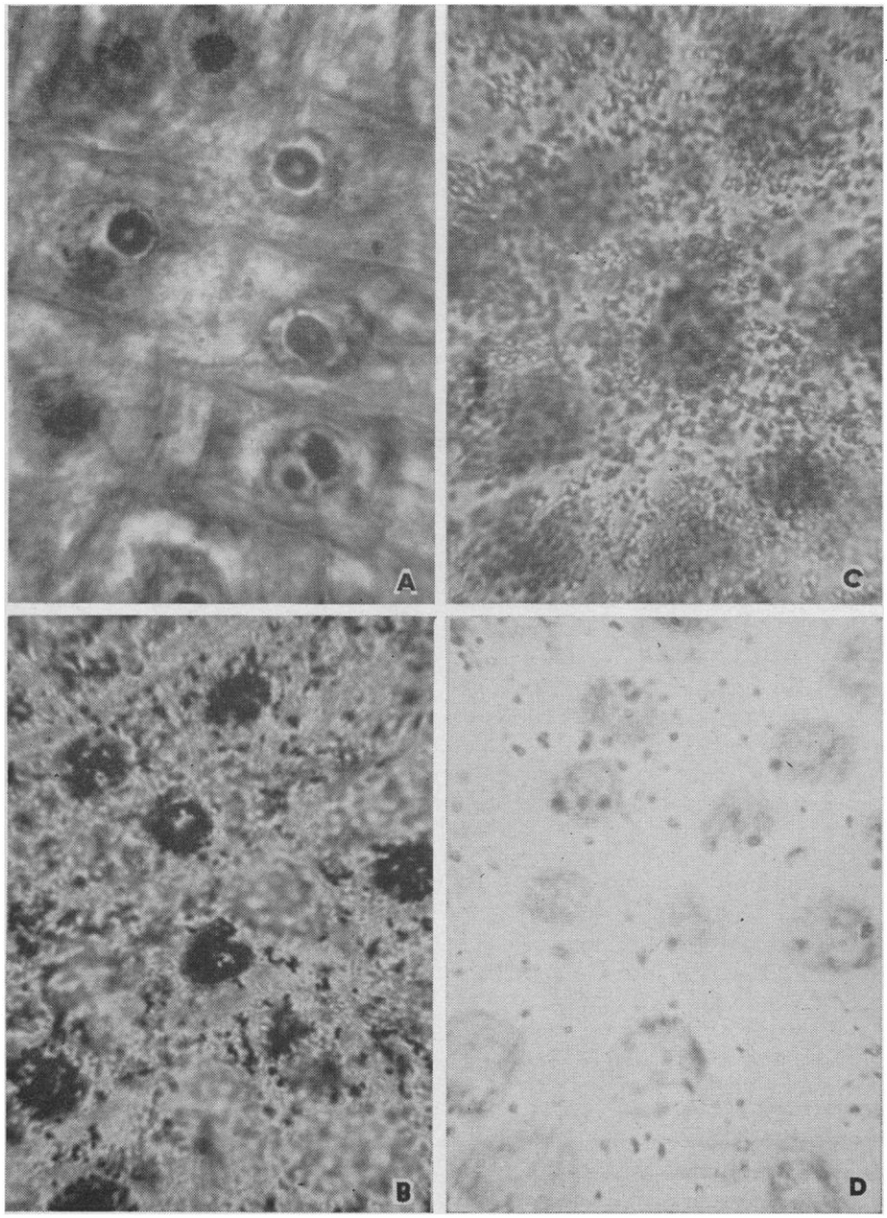

Fig. 1. Autoradiography of pea-root cells: (A) Before treatment with 6-methylpurine-H^3. (B) After incubation with 6-methylpurine-H^3 (5 μc/ml) for 1 hour. (C) After pulsing with 6-methylpurine-H^3 (5 μc/ml) for 1 hour and subsequent chasing with nonradioactive 6-methylpurine for 23 hours. (D) After same treatment as for (B) and subsequent treatment with ribonuclease (0.2 mg/ml) for 1 hour at 37°C. Film exposure, 5 days.

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